Chapter 9
The Integration of English Language Development and Inquiry Science into a Blended Professional Development Design

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Introduction

The directive from science education reform documents is clear; all students should have opportunities to participate in scientific inquiry throughout their K-12 education (American Association for the Advancement of Society 2009; National Research Council 2012). However at the elementary level, science is often overlooked or underemphasized due to the pressure to perform well on math and language arts assessments (Dorph et al. 2011). Access to science is further diminished in schools with large populations of English Language Learners (ELLs) where the urgency to develop English proficiency is an additional pressure on teachers and students (Brown and DiRanna 2012). Instructional policies often exclude ELLs from equal access to quality science instruction in an effort to hasten their English language development. This restricted access to science affects a significant number of students; in California, where this study took place, more than 22 % (1,413,549) of K-12 students and nearly 35 % of K-4 students are English Language Learners (California Department of Education 2015).

Contrary to this approach, a substantial and growing body of research suggests that English Language Development (ELD) and science instruction are complementary (Gomez Zwiep and Straits 2013; Gomez Zwiep et al. 2011; Lee et al. 2013; Stoddart et al. 2002; Yore et al. 2006). Inquiry science can provide a learning environment where collaboration and peer-to-peer talk is a natural part of how students make meaning. Given the hands-on nature of inquiry science, it also can lower the linguistic burden for students while they engage in this learning (Lee et al. 2006). Furthermore, the integration of scientific inquiry and second language acquisition can promote higher-order thinking (Stoddart et al. 2002) that is often absent when

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A.W. Oliveira, M.H. Weinburgh (eds.), *Science Teacher Preparation in Content-Based Second Language Acquisition*, ASTE Series in Science Education,
DOI 10.1007/978-3-319-43516-9_9

lessons are dependent upon an ELL's English-based literacy skills for complexity. The potential for language learning during science instruction is great, but what should an ELD-focused, inquiry science lesson look like and could it actually achieve this potential?

Setting

We began our work with a large, urban, California school district in 2008. At the onset of our project the district was serving a culturally and linguistically diverse population with large numbers of English Language Learners (56 % of K-4 students) and students living in poverty (81 % of K-4 students) (California Department of Education 2015). For the majority of ELL's in the district Spanish was the primary language (98 %, California Department of Education 2015). The district served neighborhoods that were more likely to function in Spanish, both socially and in commerce, limiting student access to English outside of the school day. Subsequently, the district had a significant number ELLs entering Kindergarten with little to no English proficiency. These students typically mastered Basic Interpersonal Communication Skills (Cummins 2008) by 2nd grade and gained intermediate fluency by 4th grade. However, ELLs often failed to develop the necessary English to engage in academic tasks (Cognitive Academic Language Proficiency) with many stalling at the intermediate-advance levels of proficiency at the end of middle school. This trend was common across all schools in the district.

The district was in danger of federal sanctions due to its failure to make Adequate Yearly Progress (AYP) towards statewide proficiency goals. An analysis of state testing data from years prior to our work indicated that the majority of all students were failing to make adequate academic progress in Language Arts, Mathematics, and English acquisition. English Language Learners were a particular concern as this sub-group consistently fell below the AYP minimum across the district at all grade levels. In response, the district mandated increased instructional time for subjects weighted heavily on state exams (i.e., English Language Arts and Mathematics). As a consequence, students received very little, if any, instruction in science. This was particularly true of ELLs who, in addition to increased Language Arts and Mathematics, received additional instruction in English Language Development.

As we began our work, the program and its goal of improving science and language learning for English Language Learners was explained to each elementary site within the district, in an effort to recruit schools. Schools were then invited to participate based on evidence of a complete, site-based commitment to the program. This commitment included the principal's and all K-4 teachers' participation in professional development and a willingness to replace the current English Language Development curriculum and to provide daily instructional time for science in grades K-4. The level of commitment ranged among participating schools but overall there was a significant level of buy-in by both teachers and site administrators from the beginning.

The teachers at our three participating schools all entered the program at similar places in their proficiencies with science and ELD instruction. For several years, the school district had invested extensive resources towards ELD professional development and virtually no resources to science in the elementary grades. Therefore, the teachers had a reasonable depth of knowledge related to ELD when the project began, but quite the opposite for their science teaching knowledge. Encouragingly, one of the main reasons teachers and principals were willing to participate in the professional development was an awareness that their science teaching needed improvement in order to more fully serve their students.

Prior to the implementation of our science/ELD blended program, the district used a popular ELD program correlated with the state's English Language Arts and English Language Development standards. This program focused on developing academic vocabulary and language skills through the use of multi-leveled reading selections and also relied heavily on teacher modeling correct forms of English and academic language use. The reading selections included fiction and non-fiction text, but topics were not aligned with content standards. In 2008, after years of using this ELD program, a total of 60 elementary teachers (grades K-4), three elementary school principals, six district second language acquisition coaches, and more than 2000 students participated in a bold change – abandoning their adopted ELD program and embedding ELD instruction into inquiry science lessons.

Teacher Professional Development Model

A professional development team comprised of district personnel, higher education faculty, and a state-wide professional development organization collaborated to assist the teachers and administrators who participated in this professional development project. The overall structure of this 3-year, professional development effort included intensive 2-week long, summer institutes that focused on a language socialization approach to second language acquisition theory and practice (Duffy 2002) and on science content and inquiry-based science pedagogy, along with site-based lesson study teams, called Teacher Learning Collaboratives (DiRanna et al. 2009) held throughout the school year. The major components of the project include professional development related to science content, science pedagogy, and second language acquisition theory and strategies.

At the beginning of the project, the professional development team approached the development of a science/ELD blended lesson design with different foci for lesson planning. Science educators advocated for the use of Bybee's (1997) 5E lesson design (i.e., engage, explore, explain, elaborate, and evaluate) as the lesson planning template. Specifically, we proposed using a version of the 5E design that included an additional section for teachers to explicitly state the science concept developed at each phase, from students' prior knowledge to the final learning goal of the lesson (DiRanna et al. 2009). This science lesson template would emphasize conceptual understanding, hands-on activities, and student interaction and support the creation of lessons that began with the elicitation of students' prior knowledge of a concept and then provide a series of experiences that allow students to build on that initial understanding. Although this focus included specific points in each lesson where students would discuss their thinking with peers and their teacher, vocabulary and specific language functions and forms were not emphasized during lesson planning.

On the other hand, the ELD professionals on our team focused on traditional ELD lessons that made the language of instruction (oral and written) accessible to learners through the use of specific language forms (e.g., grammatical features or word usage) and language functions (i.e., the task or purpose, such as compare). Within a lesson, language was made accessible through the use of explicit instruction, modeling, and scaffolding by the teacher (Duffy 2002). Language forms and functions were scaffolded with predetermined sentence frames that students could use to build language (for example, "I think ______ because ______."). Sentence frames provided necessary support for students to generate sentences and express their thinking as students often possess vocabulary specific to the content, but lack the words or phrases necessary to construct sentences. In addition, ELD lessons often front-loaded language, pre-teaching specific grammatical structures and vocabulary prior to their use in a cognitive task. In ELD lessons, language instruction was often embedded in content-based lessons, but conceptual understanding of that content was not always emphasized; the goal was the development of English language skills (Echevarria et al. 2008).

Our science education philosophy was grounded in inquiry instruction where concepts and language unfold out of student-centered learning experiences, while our ELD philosophy relied more on highly-facilitated instruction where the teacher frames, directs, and monitors student language use, accommodating for varied English language proficiency levels. However, in reconciling these two philosophies learning opportunities were created that provided access to rigorous science content for English learners while simultaneously developing their proficiency in English language. The richness of the blend was due to several factors. First, science practices and thinking skills mirrored functional language purposes (e.g., describing, comparing, citing information). Second, science content provided a highly-contextualized setting for language development. Finally, science provided important opportunities for students to engage in and demonstrate complex thinking, even if students were not yet proficient in English. However, success in this approach was dependent on several considerations. Vocabulary, along with specific language functions and forms, needed to be carefully examined for what, when, and how they would be used. Determinations of which new words should be embedded in the lesson and which new words should be front-loaded (pre-taught) were based on the instructional goals of the lesson. And throughout the lesson student thinking needed to be prioritized; as such, the science should not be simplified in an attempt to simplify language.

Year 1

During our first summer institute, teacher professional development occurred in three sessions: science content, science pedagogy, and second language acquisition. While the science pedagogy and second language acquisition sessions were designed to improve the implementation of science and language development learning experiences for students, the science content sessions were designed to increase teacher understanding of both scientific ideas and science practices. Approximately half of each summer institute was dedicated to deepening teachers' science content knowledge through these content sessions, which focused on teacher learning and were delivered at an adult learner level to provide rich, and challenging, inquiry learning experiences. These inquiry experiences provided context for authentic language use while participants struggled to make meaning of challenging content.

The placement and relationship among the three different sessions changed each year to increase their connection and explicit use by facilitators. In the initial year of the project, the three components were presented as separate elements to teachers. However, even at this early stage, the facilitators purposefully merged specific elements to model the integration of science learning and language elements during each session. For example, science content sessions utilized models and strategies presented in pedagogy sessions, including the using the 5E lesson design and integrating facilitated questioning strategies and linguistic supports, such as the use of realia, partner talk, sentence frames, and other linguistic supports.

During the school year, teachers participated in three rounds of grade-level specific, lesson study. The lesson study rounds were each 2 days long: 1 day for collaborative planning and 1 day for collaborative teaching and reflection. The first day of the lesson study supported teachers in planning a 5E science lesson and then blending into the lesson specific second language acquisition elements to build students' proficiency in English. On the second day, teachers collaboratively taught the lesson twice, with time to modify the lesson between teaching rounds based on their analysis of student work produced during the lesson.

Year 2

Once participating teachers had a foundation of science and language pedagogy, the second year of the institute was more explicit in the merging of science and language. Although, many teachers began the program with established expertise in using appropriate strategies for English Language Learners, they did not always know how to use these techniques within a science context. Summer institute sessions were designed to demonstrate how typical language development strategies could support students' language and learning as students discuss and debate ideas about scientific phenomena. In the second summer institute, the second language acquisition sessions used material from content sessions as context for discussion

Science Objective:					
Science Standard:					
Language Objective:					
ELD Standard:					
	Teacher Does	Student Does Differentiated by Language Level			Science Concept and Language Function
		Low	Medium	High	
Engage					
Explore					
Explain					
Elaborate					
Evaluation					

Fig. 9.1 Science/ELD blended lesson design template. This modified 5E lesson plan template identifies science concept development, language function, and teacher and student actions. Student actions are differentiated based on language proficiency level

and exploration. To accomplish this second language acquisition experts participated in the science content sessions, noting the types and forms of language used by participants as they explored topics such as properties of matter, force, and motion. A sequence of planning was made explicit: science first, language second. This sequence was followed in both the presentation of session materials and the protocols for teacher-developed lessons. This sequence ensured that the science content was accurate and appropriate for the grade-level, avoided artificial and awkward language that may have obstructed student thinking, and utilized teachers' natural discussion during their collaboratively-planned science lessons to identify student language needs.

In our second year, the science/ELD blended lesson design template (Fig. 9.1) was formalized. This 5E-based template included columns for teacher actions and student actions, as well as places for teachers to identify the science concept and primary language function developed during each phase of the lesson (Gomez Zwiep et al. 2011). Language functions were added to the lesson template to encourage teachers to pre-think which language functions would naturally emerge during the inquiry and would require support. Identifying the function of language that students would be using during the science lesson allowed teachers to select and use the appropriate linguistic scaffolds such as sentence frames and graphic organizers. For example, if students were creating descriptions teachers would employ strategies to support describing; if students were comparing and contrasting, teachers would employ a different set of linguistic scaffolds. The student action column was divided into sections to focus teachers on the varied English proficiency levels in their classrooms. These sections provided a place for teachers to plan specific strategies based on language function and specific to each proficiency level. For participating teachers, the use of language functions were a familiar part of ELD lessons; teachers had great experience with their use. Here, teachers applied this expertise as they designed science lessons that provided an authentic and natural use of a language function within a context-rich environment.

During the lesson study sessions, facilitators pushed teachers to be more specific about student responses, such as specifying language frames at each stage in the lesson. For example, if students were asked to recall information about the properties of rocks in the engage phase of a lesson, teachers might discuss the prior knowledge students might have about rocks and how students might communicate that knowledge; the facilitator would then encourage additional discussion about means for eliciting and representing these student ideas, such as using drawings, graphic organizers, or sentence frames, and what these might look like at different levels of proficiency. This allowed for more specific language support, and made it easier for teachers to engage students with limited English skills in more scientifically-rich conversations and activities.

Year 3

The blended design developed further during the final year of the project. As teachers grew in their sophistication, our discussions of science and language became increasingly seamless. To a great extent the professional development and the work of teachers was "science/ELD" and not, "science" and "ELD." We continued to provide much-needed science content, but our science pedagogy and language development pedagogy sessions were largely devoted to facilitated planning time for teachers to develop, through a multi-step process (see Appendix), their own blended lessons and units. The content sessions included an explicit focus on the nature of science, emphasizing scientific forms of discourse, such as the use of evidence and reasoned arguments. These sessions emphasized how language is used within the scientific community to validate or discredit new ideas through public debate (written and oral) (Osborne 2014). These "scientific" forms and uses of language were introduced to teachers, helping to further solidify the link between science and language.

During this final year, it was decided that within our blended lessons students needed more room to express their ideas and that more room was needed for the use of primary language and "imperfect" language (Lee et al. 2013). Initially, we thought it was necessary for language functions and frames to be identified in each phase of the 5E lesson design. However, as teachers developed their expertise and students were exposed to quality science instruction, the role of imperfect language became evident. Opportunities for less structured language were created within the summer professional development sessions and included in the lesson study protocol used during the school year. Allowing students more freedom in how they communicated their thinking created deeper science understanding and promoted language development opportunities. Primary language and "imperfect" language was given more room in the first phases of the 5E lesson to allow natural language and space for student thinking while science understanding is developing. Sentence frames and other linguistic supports that focused on correct grammatical structure were removed from the first two phases (engage and explore) of the lesson. However, formal second language supports are still included in the later phases (explain and elaborate) of the lesson to help students articulate their thinking.

Materials

Although this professional development project aimed to support K-4 teachers in teaching science/ELD blended lessons, at the outset the professional development team did not have a vision for what science/ELD blended lessons should look like. The planning tools we presented to teachers were living documents with elements added, amended, and completely thrown out during the course of the project. We made herky-jerky progress. And, in the end, had a blended science/ELD lesson planning tool that teachers found highly effective (Appendix).

Outcomes

In an effort to better understand how this project impacted teachers' practice, we analyzed teacher-generated lesson plans, observed classrooms as teachers implemented these lessons, and conducted semi-structured interviews with participating teachers and principals throughout the project. Selective coding (Charmaz 2002) was used to sort, synthesize, and conceptualize the emergent qualitative data by adopting frequently appearing initial codes relevant to the focus of the study. Coded data that posed coherent sets of ideas, were organized into categories. These categories were revisited as new data provided alternative vantage points for re-interpretation. Ultimately, those categories that sustained coherent and plausible interpretations were organized as key insights. These insights provide perspective on the impact the blended program had on teachers, students, and the overall school culture.

Enhanced Status for Science

It is an understatement to say that prior to the implementation of the blended program, science was not a priority at our participating elementary schools. In fact, teachers reported that, when new science textbooks were adopted in 2008, at the end of the 7-year curriculum cycle, they turned in brand new science textbooks, never opened. "We all joked when we were turning them that some of us let the kids take them home for a week before we turned them in so that they would look more used." However, the status of science changed with the implementation of the new program. This was in part because the program required science be part of ELD which long had dedicated instructional minutes during the school day. As one teacher explained,

> English language development has always been a key focal point. It is so engrained in us that we need 45 minutes a day, no matter what. Putting both of them [science and ELD] together makes science one of the top priorities. Before it was we had half an hour a week to teach science, social studies and P.E. Now science is taught everyday.

Science became a "top priority" primarily because of its link to student English language development and the importance of English proficiency for success during state testing. Because high-stakes tests are often given in English, the performance of English learners is often indicative of their English proficiency rather than the skill or knowledge being assessed. Given this and the long history of emphasizing ELD at our participating schools, it was not surprising that connecting science to ELD heightened the importance of science in the eyes of teachers and administrators. What was surprising to participating teachers was students' responses to science.

Students at the participating schools were excited about science and looked forward to their science lessons. While the hands-on, process of discovery is often intrinsically motivating for students, there was more to the additional appeal of science for students than engaging lessons. From the student perspective, the program was seen as a switch to science rather than a different approach to ELD, lifting away their perceived negative stereotypes related to the label "English Learner." Prior to the project, students who were considered proficient in English were given full access to the curriculum; students designated as English learners received additional instruction in English at the expense of participating in other subjects, such as science. As one teacher reported, "One of my students told me, 'I don't go to ELD anymore, now I get to go to science instead.'" Additionally, perhaps due to the fact that science is now seen as a privilege, students have fewer behavioral problems during science lessons compared to other instructional times during the day. "Now I don't have any real behavior issues. Now I just say, 'Is that how scientists act?' and they get back into it. They're really intense." This came as a surprise to teachers who had previously expressed fear of keeping students on task and behaving appropriately during science, as a major factor discouraging them from hands-on science.

Increased Use of Oral Language

A critically important impact of students' excitement for science was that students became excited about talking about their ideas and new learning in science. Across the board, teachers and school administrators were overwhelmed with the students' increased use of English. Teachers reported this increase in both oral and written English, but seem most impressed by students increased use of oral language. Teachers were noticeably delighted when they described the change in their students' willingness and ability to communicate in English. "It is much more exciting so kids are willing to talk more, in English." "You should see the vocabulary they [students] use now, 'we predicted today, we did some observations.'" This increase in English use extended beyond science and beyond the classroom. Principals and teachers across the participating school sites described an increase in English use in other content areas and in non-classroom settings such as recess or in the office when speaking to support staff. School principals reported that students often want to tell them about the science activity, book, or lesson they are learning about in class, "When I am walking around the cafeteria or see the children walking out of the library they can't wait to tell me about the different planets, rocks and minerals, or erosion." Principals also noted an increased English language use beyond academics. "We had a group of students in the office trying to settle a dispute that occurred on the playground and they were using English even though the office staff are fluent in Spanish. That was a first around here." This increased use of oral language, both within and outside the classroom, was perhaps the most apparent and wide-ranging impact of blending science and ELD instruction.

Changes in Teacher Perceptions

Our close work with teachers provided important insights to teachers' creation and implementation of science/ELD blended lesson plans. Many of these are not earth-shattering for teacher educators, but were enormously enlightening for individual teachers as they grew in their understanding of effective teaching and their ability to critique their own practice. In particular, teachers grew to be more effective in and critical of their planning for instruction and structuring of lessons. As stated by a teacher,

> It is how I teach it that is going to give me the desired outcome. If I expect the child to know this then I need to guide them to that place and not expect it to come out of the blue somewhere in my lesson. It makes sense, but I never thought about it that way before.

Participating teachers shared additional ways they had grown as professionals, most prominently in terms of their expectations of students and the affect these new expectations have on their pedagogy. Many teachers interviewed described a shift in thinking about what a child with limited English is capable of learning, becoming more focused on how they structure learning in their classrooms and less focused on the label of a student. "Even my low EL learners can verbalize these things [science understandings]. You have to expect them to because sometimes it is just the language and not that they aren't thinking these things in their minds." Teachers often commented on the belief that their students can have a good understanding of the science, but be limited in their ability to express that thinking by their language ability. In other words, a limited student response might represent limited English skills rather than limited conceptual understanding. For example, although our teachers believed sentence frames to be essential scaffolds for students with limited language skills; they grew to understand that the sentence frames they provided limited student responses and resulted in student work that failed to display the range of content understanding. This critical insight led teachers to explore additional measures of student understanding (especially for students with beginning language skills) that were not as language dependent – developing assessments that included graphic organizers, pictures, and asking students to physically manipulate materials.

Student Achievement

Of course, teachers and administrators didn't just tell us about the benefits of the program, they also told their peers at other schools and the science/ELD blended lesson design spread across the district. But this spread, not to mention the sustained enthusiasm of our participants, may not have occurred if it not for the program's impact on student achievement data. Student achievement was measured using existing state-mandated tests in English Language Arts and English Language Development. The number of students in the sample varied depending on the number of students who were present and completed the assessment each year. However, all students at the three treatment and two comparison schools with a valid score on these assessments were included in the sample. Comparison schools were chosen based on similar student demographics (socio-economic status, ethnicities, percentage of ELLs) and previous performance on state assessments. In the analysis of student achievement data, a response variable of mean improvement from a baseline year was used. Baseline was determined by the year a student started at the school site. There is not one baseline, but rather multiple ones corresponding with each student's arrival at the site (i.e., when they began the program). This provided a richer sample for analysis than using a single baseline for analysis allowing all students who had a score on any measure to be included in the sample. For example, for a 1st grader who began in the school year 2006–2007 the analysis followed the improvement from 2007 to 2008 (Year 1 improvement) to 2010–2011 (Year 4 improvement). Since the analysis used student proficiency levels, an ordinal variable, non-parametric statistics were used. Group statistics and Mann–Whitney U tests were performed on state assessment data to compare differences between the comparison and treatment schools. A Bonferroni correction was used to help reduce the overall type 1 error rate to 5 %.

This project began when, in desperation, schools were willing to remove their district's established and widely used curriculum in favor of a novel approach to both elementary science instruction and English language development. In so doing, we essentially "stole" instructional minutes from second language acquisition to make room for science, a subject that, prior to our project, was rarely taught. Honestly, we would have considered our project a success if participating students simply continued to develop their English language skills at a rate similar to those of students who used the state-adopted English Language Development program. Instead, results from student assessments indicate that the English language proficiency of students in the blended program, when compared to students participating in the traditional ELD program, actually improved. Although gains were modest, improvement was seen across multiple indicators and through different means of data analysis (overall proficiency, sub-skills, multiple years of treatment).

There were statistically significant gains in student performance on the California English Language Development Test for students with 1, 2, 3 and 4 years of participation ($U=4.226$, $U=5.205$, $U=5.134$ and $U=5.321$, respectively and $p=0.000$ for all years). Significant improvements were seen in student performance on the California State Test, English Language Arts for 1, 2 and 4 years of participation ($p=0.000$, 0.004, and 0.040 respectively). In particular, participation in the blended program appears to have had a positive affect on students' oral language development (i.e., listening and speaking). For many in our district, this was the proof that mattered and it has helped to sustain science instruction at our participating schools and others in the district.

Summation

This project developed a successful method for improving K-4 students' English language skills. Success was a direct result of the blended lesson design's focus on creating opportunities for students to work collaboratively, discussing and debating their ideas with evidence from scientific investigations. Student-to-student dialogue is a major component of the blended lesson design, as scientist-to-scientist dialogue is a central component of the scientific enterprise. These opportunities need to be carefully crafted to allow students space to explore new science concepts and using manipulatives and other realia (Lee et al. 2013; Snow 2010). Teachers should provide language scaffolds, but these carefully crafted language supports should not interfere with the scientific inquiry central to the construction of new scientific knowledge. Vocabulary essential for participation during science investigations (hard, blue, smooth) is front-loaded and language frames are provided, but these are designed to support authentic scientific inquiry and maintain the central role of student thinking within instruction. Learning occurs best when students feel safe to share their developing science ideas, with whatever communication skills they possess, including possibly imperfect language. The lesson design should provide linguistic supports that allow space for student ideas to develop and promote communication while still acknowledging student contributions for their value within scientific discourse. This provides a more authentic and rich environment for both science and language development. In this project, we did more than simply replace science topics for the existing topics in the ELD instructional materials; we attempted to integrate the best of both science instruction and English language development.

The successful blending of inquiry science and language development requires a significant level of skill and knowledge. Science specific pedagogical content knowledge is needed to identify the optimal moments to support language within science while keeping the inquiry and rigor of the science intact. Which language forms or functions are necessary for students to fully engage in the science learning and which would stifle their explorations are decisions best made by teachers who possess great knowledge of second language development and command a deep understanding of science content. Therefore, although some measure of success could be achieved without it, extensive teacher professional development is needed to optimize use of the blended science/ELD lesson model. With this support, science classrooms can be rich language learning environments where ELLs use and develop language to make sense of scientific phenomena around them.

Appendix: Planning Sequence of 5E/ELD Lesson Design

In teachers' use of the science/ELD blended design template a specific sequence was followed. This sequence begins with identifying the development of a science concept through the 5Es (Step 1). Teachers then develop details of an inquiry science lesson designed to achieve each conceptual goal independent of language objectives (Step 2). Finally, teachers modify the lesson by adding appropriate ELD support (Step 3). This sequence is illustrated in the tables below. For Steps 2 and 3, only the Engage phase of the lesson is shown. For further details regarding this sequence see, Gomez Zwiep et al. 2015).

Step 1: Plan conceptual storyline of each E

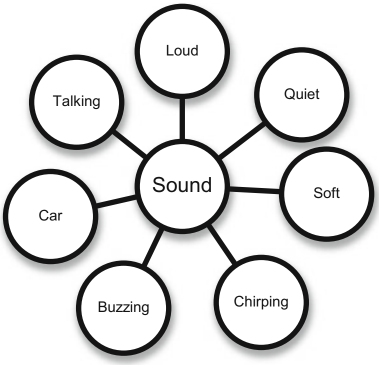
	Teacher	Student	Science concept
Engage			SC: Sounds can be heard all around us
			Sounds have different qualities
Explore			Sounds are made by vibrations. Changing the vibrations can change the sound
Explain			Vibrations cause the sounds to be created. Different kinds of sounds can be made from the vibrations
Extend			Sounds can be high or low (precursor to pitch)

Step 2: Develop science lesson sequence and predict student responses

Teacher	Student responses	Concept
I want everyone to close your eyes and listen to all of the different sounds that you hear		SC: Sounds can be heard all around us
		Sounds have different qualities
Give students 30 s to a minute to listen for sounds. (If the school area is particularly quiet, make some sounds like crumpling up a piece of paper or banging a trash can.)		
What were the sounds like?	Bird, Boys, Talking, Bugs, Cars	

Step 3: ELD supports: Identify appropriate language function match; insert appropriate language scaffolds; adjust Expected student responses for proficiency levels of students in the class

<table>
<tr><th>ENGAGE: Teacher</th><th>Low</th><th>Med</th><th>High</th><th>Science concept/ Language function</th></tr>
<tr><td>I want everyone to close your eyes and listen to all of the different sounds that you hear

Give students thirty seconds to a minute to listen for sounds. (If the school area is particularly quiet, make some sounds like crumpling up a piece of paper or banging a trash can.)</td><td></td><td></td><td></td><td rowspan="6">SC: Sounds can be heard all around us
Sounds have different qualities
LF: Describing</td></tr>
<tr><td>Turn to your partner and tell him or her what sounds you heard
Partner A will tell partner B one thing they heard
Then, partner B will tell partner A one thing they heard
Keep going until you have shared all the things you heard</td><td></td><td>The birds outside, Students next door, Flies buzzing</td><td>I heard whispering, It was loud yelling, The buzzing was tiny.</td></tr>
<tr><td>(Students take turns sharing with their partners).</td><td>Bird, Boys, Talking, Bugs, Car</td><td>It was soft</td><td></td></tr>
<tr><td>What were the sounds like?
Turn to your partner and describe the sounds
Who can share with the class something their partner shared?
Record the types of sounds on the board/graphic organizer as students share</td><td></td><td></td><td>I heard students in the class next door.</td></tr>
<tr><td>Bird chirping, talking, cars, buzzing, loud, quiet, soft

</td><td colspan="3" rowspan="2">Student share ideas from their partner talk.</td></tr>
<tr><td>Great! So there are different types of sounds around us. Let's find out more about sounds.</td></tr>
</table>

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